SECTION 1

INTRODUCTION

BACKGROUND

During the period of August 1971 through April 1973, the Interdepartment Radio Advisory Committee (IRAC) had under study the accommodation of Department of Defense (DoD), Federal Aviation Administration (FAA), and Department of Commerce (DoC) radar operations in the band 2.7-2.9 GHz. A series of meetings was held between the agencies (Summary Minutes of the First (October 1972) and Second (December 1972) OTP Meetings) to determine if new FAA air traffic control radars could be accommodated in this band without degrading their performance, and what impact these radars would have on the performance of existing radars in the band. An initial assessment of the problem (Maiuzzo, 1972) determined that the addition of new radars to the band could create a potential problem. To resolve the immediate problem of accommodating the new FAA Air Traffic Control Radars, the following actions were taken:

a. The band 3.5-3.7 GHz was reallocated by footnote to provide for co-equal primary Government use by both the Aeronautical Radionavigation and Radiolocation Services. The footnote reads as follows:

> G110 - Government ground-based stations in the aeronautical radionavigation service may be authorized between 3.5-3.7 GHz where accommodation in the 2.7-2.9 GHz band is not technically and/or economically feasible.

Agencies were requested to cooperate to the maximum extent practicable to ensure on an area-by-area, case-by-case basis that the band 2.7-2.9 GHz is employed effectively.

b. The Spectrum Planning Subcommittee was tasked to develop a long-range plan for fixed radars with emphasis on the 2.7-2.9 GHz and 3.5-3.7 GHz bands. The SPS plan (SPS Ad Hoc Committee, 1974) was completed and approved by the IRAC.

The Office of Telecommunications Policy (OTP)* subsequently tasked the Office of Telecommunications (OT)* to perform a spectrum resource assessment of the 2.7-2.9 GHz band. The intent of this assessment was to provide a quantitative understanding of potential problems in the band of concern as well as to identify options available to spectrum managers for dealing with

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* OTP and OT have been reorganized into the National Telecommunications and Information Administration (NTIA) within the Department of Commerce.

these problems. One of the primary reasons for initiating the assessment was to ensure identification of problems during the early phases of design and planning rather than after-the-fact, i.e., after a system has been designed and hardware fabricated. By making these band assessments early, necessary actions can be taken to assure that appropriate communication channels are established between agencies whose systems are in potential conflict. This will enhance the early identification of solutions which are mutually satisfactory to all parties involved.

A multiphase program to the solution of the 2.7-2.9 GHz Spectrum Resource Assessment task was undertaken by NTIA.

Phase I - The first phase involved the identification of systems existing in and planned for the band in question, determination of available technical and operational data for each system, identification of the potential interactions between systems, and the generation of a plan that leads to an overall assessment of the band's potential congestion. A Phase I report (Hinkle and Mayher, 1975) for the 2.7-2.9 GHz Spectrum Resource Assessment was completed.

Phase II - The second phase encompasses several tasks:

1. A detailed measurement and model validation program in the Los Angeles and San Francisco areas. The objective of this task was to validate models and procedures used to predict radar-to-radar interference, and assess the capability of predicting band congestion. This task was completed and the findings are given in a report by Hinkle, Pratt, and Matheson (1976).

2. Investigation of the signal processing properties of primary radars in the 2.7-2.9 GHz band and the Automated Radar Terminal System (ARTS-IIIA) to assess the capability of the radars to suppress asynchronous interference and the trade-offs in suppressing asynchronous signals.

3. Investigation of the potential band congestion and band efficiency in eight designated congested areas (New York, Philadelphia, Atlanta, Miami, Chicago, Dallas, Los Angeles, and San Francisco) based on the technical findings of Tasks 1 and 2.

4. Development of engineering and management aids to assist the frequency manager in determining if new radars can be accommodated in the 2.7 - 2.9 GHz band, and a methodology for assessing how efficiently the band is being utilized.

This report is the second Phase II report in a series of reports related to the Spectrum Resource Assessment of the 2.7-2.9 GHz band. The nature of the 2.7-2.9 GHz spectrum resource problem requires a rigorous analytical and measurement investigation into the signal processing properties of the radars presently in and planned for the 2.7-2.9 GHz band as well as the ARTS-IIIA

post processor used in the FAA Terminal radars. This report contains the investigation of the signal processing properties of the radars and post processors to noise, desired signal, and interfering signals to access the capability of the equipment to suppress asynchronous signals and the trade-offs to the desired signal in suppressing asynchronous signals. This investigation was necessary to assure that the investigation of potential band congestion will be based on sound technical procedures.

OBJECTIVE

In order to promote effective use of the band, it is necessary to determine the electromagnetic compatibility of present and future radars planned for deployment in the 2.7-2.9 GHz band. The second task of the Phase II program encompassed a detailed investigation into the signal processing properties of the primary radars and ARTS-IIIA post processor. The objectives of this extensive signal processing investigation were to:

1. Determine the signal processing properties of radars presently operating or planned for the 2.7-2.9 GHz band and the terminal radar ARTS-IIIA Radar Data Acquisition System (RDAS).

2. Investigate the trade-offs to desired signal detection in suppressing asynchronous interfering signals, and determine methods to minimize these trade-offs.

3. Determine methods of obtaining more efficient utilization of the band by using interference suppression techniques.

APPROACH

In order to accomplish the objectives related to the radar signal processing task, the following approach was taken:

1. Conduct a preliminary investigation to determine the radar nomenclatures presently operating in the band, and the new radars and post processors planned to be used in the band.

2. Perform a cursory investigation into the operating modes (i.e., normal, log-normal, Moving Target Indicator (MTI), weather background, etc.), types of circuitry and processing techniques (analog or digital) used by radars in the band to determine the representative radars to be analyzed in detail.

3. Perform a detailed signal processing investigation of the transfer properties of the representative radars to noise, desired signal, and interfering signals using analytical techniques, measurements, and simulation.